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FOREST INSECT LABORATORY,
UNIVERSITY OF CALIFORNIA,
BERKELEY, CALIFORNIA.

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Quincy, California,
October 9, 1910.SS
Lassen, Studies,
Insects.*Lodgepole Infestation Lassen*Forest Supervisor,
Mineral, California:

Dear Mr. Kling:

I submit the following report of the forest insect investigations which were made upon the Lassen National Forest during the period from September 6-20, 1910.

I enclose herewith a map of the Forest showing the route followed during the investigation. Three days were at the headquarters at Mineral, but the remainder of the time was spent with Forest Agent Boldenweck in the infested territory in the southeastern part of the Forest. Outside of this infested territory in nearly all parts visited, occasional trees were found which had been weakened or killed by insect attack. I will later mail you a list of these with a small labeled collection of the important species affecting the timber trees. However the problem of insect control has become a serious one in the lodgepole pine, and for the present it seems best to devote this report to its discussion.

Location and Extent of the Dying Lodgepole

This was reported by Mr. Boldenweck in his letter of July 2, 1910, and was outlined as extending through different

sections of townships 29 and 30, North, in ranges 7, 8, and 9 East, MDM. Following this report and observations made in the field, I have outlined this area on the enclosed map. Practically all of the lodgepole pine in the territory visited east of Range 4 East, contained more or less of this dying and infested timber. There appear to be certain centers of attack where the work of insects is decidedly pronounced and practically 90% of the stand has been killed, leaving alive only the small trees and reproduction. From this wholesale condition of attack the amount of dead and infested trees grade off into stands where only small groups of from five to twenty trees appear which do not constitute more than 5% or 6% of the stand.

The areas where this outbreak is at its worst lie within the basins of Robber and Bailey creeks, both of which contain, in places and on small areas, an almost pure stand of lodgepole pine. The basin of Rock creek which lies between these two, also contains considerable dying timber, but it is probable that the percentage here is much lower. The location of these centers of attack by legal subdivisions is as follows:

Robber creek basin:

Sections 16, 17, 22, 27, 34, 35, and 36 in T30N, R8E, MDM.

" 1, 2 and 12, T29N, R8E, MDM.

" 17, 18, 19 and 20, T29N, R9E, MDM. (These in the vicinity of Duck lake).

Bailey creek area.

Sections 2, 3, 10 and 11, T29N, R8E, MDM.

Rock creek area.

Sections 17, 18, 19, and 20, T29N, R8E, MDM.

This is only an approximate location of the dying timber. On account of the limited time in the field the entire territory could not be carefully gone over. Besides

the habit of the insect which is causing this, is such that the trees which are attacked during the summer will not show death by the coloring needles until the following spring. This makes it possible to locate the newly infested trees only by careful inspection.

History of the Outbreak.

One of the most striking features of this outbreak is its sudden development. More than half of this lodgepole has been killed during the past three seasons. The information furnished by cattlemen places the first noticeable appearance of the dying groups of trees during the seasons of 1903-4, or about seven years ago. These kept steadily increasing, but during the last two or three seasons there has been such a rapid increase in places that scarcely any trees over ten inches in diameter are living.

These statements of the cattlemen are supported by the evidence of the trees themselves. More than half of the dead trees still have the brown needles adhering, which shows that death has been quite recent. There is a much smaller percentage of trees from which the needles have fallen, and the weathering of the bark and wood shows that they succumbed some time ago. But the evidence of very old insect work is only seen occasionally.

It is probable that a very small percentage of the trees have always been dying from the attack of this insect as they are found in almost all stands of lodgepole. However favorable conditions have some way encouraged the development of the insects to such an extent that they threaten not only

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the remainder of the lodgepole on the area but the surrounding forest of yellow and Jeffrey pine as well.

On account of the uneven distribution of the work of the insects it is very hard to get an estimate of the dead and infested timber without taking the time to secure accurate figures. I am of the opinion that Mr. Boldenweck's estimate of last summer, that about 35% of the entire stand of the southeastern lodgepole on this portion of the Forest is affected, is about correct. This of course represents only the trees which were attacked and killed prior to the season of 1910. The trees which have been attacked and killed during the present season will not be very much in evidence until the spring and summer of 1911.

The Primary Cause-The Mountain pine beetle (*Dendroctonus monticolae* Hopk)

Frequently in the case of insect attack there is a complication of causes, such as fungus and barkbeetle work combined, but in the present territory there is no reason to believe that there is more than one agent primarily causing the death of the lodgepole. The freshly attacked trees are thrifty, without evidence of disease, and the annual rings show active growth up to the present season. On the outer bark are little masses of pitch and sawdust; under these, marked upon the inner bark and the outer layer of sap wood, are small long cylindrical tunnels about a quarter of an inch in diameter, following the grain of the wood; and smaller irregular tunnels, filled with packed sawdust, which cut across the growing bark and wood and complete the girdling of the tree.

These are the egg galleries and larval mines of the mountain pine beetle, (*Dendroctonus monticolae*, Hopk.)

Following closely upon the attack of the mountain pine beetle, is that of the engraver beetles, Ips emarginatus and Ips sp., and the bluing fungus. In no case however have I found these to be primary.

Life History and Habits of the Mountain Pine Beetle.

Dr. A. D. Hopkins describes this beetle as follows:

"The mountain pine beetle is a stout, black, cylindrical bark beetle 3.7 to 6.4 mm. long, having the head broad, without the frontal groove, but with a short longitudinal impression above the middle; the prothorax short, broad, and punctured, with the sides narrowed and slightly constricted toward the head; the elytra with moderately coarse rugosities between the rows of punctures, the latter usually indistinct on the sides; the declivity slightly impressed each side of the suture, and with a few long hairs, the striae narrow, and the spaces between quite broad and roughened, with sparsely placed granules. It attacks injured, felled, and healthy silver or western white pine, western yellow pine, and lodgepole pine, in Montana, western Wyoming, Idaho, Oregon, and Washington; it also attacks sugar pine, western yellow pine, and lodgepole pine in the mountains of Washington, Oregon and California."

Evidences of Attack.

In the present territory, the first external evidence of attack upon living trees with normal green foliage is the presence of pitch tubes upon the outer bark. These are

little ,reddish-brown masses of pitch and sawdust which exude through the small cylindrical entrance made by the adult beetle where it bores through the outer bark, to begin its egg tunnel. Each of these pitch tubes represents the entrance of ^{or more} one/of these barkbeetles. Some reddish sawdust from the borings is also thrown out through the entrance which lodges in the flakes of the outerbark, or on the ground around the base of the tree. This is another evidence of attack, and of the presence of the barkbeetle in the tree. After exposure on the bark for one seas on the pitch tubes turn yellowish or grayish white, many of them falling off.

The number of pitch tubes on any one tree depends upon the severity of the attack. The habit of the mountain pine beetle appears to be to attack by swarms. Certain trees are selected, usually located in groups of from two to twenty, and the beetles bore into them in great numbers. Usually, under normal conditions, weakened or fire-injured trees are first selected, but in the present instance, this rule does not apply.

Perfectly healthy trees are selected and riddled, while those standing just adjacent to them are left untouched. Some of the smaller/^{infested} trees have as few as ten or fifteen pitch tubes near the base, while some of the larger ones which are much more severely affected, will have just as many as the bark surface will conveniently permit for the entrance of the barkbeetles and their subsequent work. A count was made of the pitch tubes upon one freshly attacked lodgepole near the Clover Valley Ranger Station. The results are as follows:

| | |
|---|-------------|
| No. of pitch tubes on lower 6 feet of trunk | -378. |
| Estimated " " " remainder " " | -400. |
| | total -778. |

As each of these pitch tubes represents the entrance of both the male and female adult beetles normally, at least 1500 barkbeetles had probably found their way into the tree.

(See photos

These barkbeetles also prefer to work in that part of the tree covered by the thicker and older bark. The majority of the pitch tubes are usually found on the lower twelve feet of the trunk. Young trees under ten inches in diameter and the upper portion of the larger trees are not molested.

(See photos, 90212, 90216, 90217, and 90219)

The fading and yellowish or red coloring of the foliage, which is a conspicuous and important evidence of the attack of barkbeetles, is not a satisfactory one in this case. Trees which are attacked during August and later (when most of the mischief is done) hold their green foliage until the following spring or early summer. In some cases the green foliage persists even longer, where only one side of the tree is killed the first year. It may be safe to conclude that by the time the needles have turned dead and brown, the barkbeetles are gone, having issued to begin their work on other trees. In fact much of the territory which is now conspicuous on account of the dead timber, is not the place where most of the active insect work is going on. The newly infested trees will have to be located by the presence of the pitch tubes and sawdust upon the bark.

Habits of the Barkbeetle.

As soon as the barkbeetle has made its entrance

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through the bark it starts to work up through the live inner bark and cambium, forming a tunnel, but little larger than the diameter of the beetle, which is known as the egg gallery. As a rule, male and female work together in one egg gallery and the eggs are deposited, singly or in approximate groups of two or three and often in little notches which are hollowed along the sides of the gallery. These egg galleries vary in shape from straight to winding, and in length from ten to forty inches. When the tunneling and egg laying process of the parent adults is completed, their activity ceases and they are usually found dead at the upper end of their burrows.

The larvae hatch and begin their development by burrowing across the cambium, directly away from the egg galleries. As soon as their development is completed they form little cells in the inner bark where they pupate and later chitinize into the imago or adult. From these pupal cells, the new adults issue, usually in swarms the following season, to attack fresh trees. The complete girdling of the cambium layer is not accomplished until the larvae have completed their work, and this probably accounts for the slow appearance of the reddish foliage.

Seasonal History.

The rapidity of this development depends upon the length of the growing and varies much in different localities. As the season here is short, owing to altitude and other conditions, it is probable that the season of activity of the bark-beetles and their larvae is not long. It is evident that the work ceases with the beginning of the cold weather, and

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and from material which I have collected on this investigation ,it seems that they pass the winter dormantly in practically all stages-eggx,larvae,pupa, add imagoes. I am at a loss for any definite notes as to the time when activity is renewed in the spring. Mr.Boldenweck who was here on June 27,28,1910, collected practically all stages then. He also found evidence of fresh work and it seems reasonable to suppose that at least some of the broods of the past season had emerged and were active at this date. More complete data can be secured in regard to this another season.

Economic effect of the beetle work upon the timber.

The larger and mature trees which represent the merchantable part of the forest are the ones first attacked and killed, Were it not for other agencies which come in,almost as soon as the tree shows signs of weakening from the barkbeetle attack, much of this timber would remain sound and merchantable long after it is killed. One of these is a bluing fungus which colors the sapwood.

Another feature which renders the wood useless is the seasoning check which appears in all the standing trees which are insect killed and stand for more than one season.

Some of these checks are are from ten to twelve feet in length,over half an inch in length on the surface, and extend well into the heart wood of the tree. Three or four of these will sometimes appear on the same portion of the trunk . It is possible that some sort of use may be found for this quality of timber,but on the whole it seems that the forest

will suffer considerable loss on account of the rapid deterioration of the insect-killed timber.
(See photos 90203, 90204).

Cause of the Outbreak.

It is hardly possible to determine just what has caused the sudden outbreak in the numbers of the barkbeetles other than natural agencies, such as the absence of parasites and favorable growing seasons. The argument advanced by some stock men, that the checking of fires under the administration of the Forest Service, is responsible for the increase of the bugs, is difficult to explain. By the time that the fire season is at its height, most of the barkbeetles have issued and are actively at work under the bark of living trees, where they are so protected by the outer bark that only a fire severe enough to scorch and kill the tree could in any way affect them. As a rule trees which have been fire-scarred and weakened form favorable breeding places for barkbeetles, and it would seem that the only way in which they could be destroyed would be by a very severe fire, capable of scorching and burning the infested trees, which occurs very early in the season.

Methods of Control.

Owing to the seriousness of this outbreak, some measures should be undertaken to check it. This is by no means an easy problem owing to the location and quality of the dying timber. Lodgepole, as yet, seems to be an untried timber on the California market, altho it has been used successfully for fencing material, cross-ties and telephone poles. As the timber now stands

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As the timber now stands, it may be very difficult to effect a sale of the lodgepole pine alone, but ^{as} it now seems possible that a railroad will make this far more accessible within a few years, every effort should be made to secure its disposal. Not only is the remaining stand of lodgepole threatened, but the same barkbeetles are capable of attacking and killing sugar and yellow pine as well, and the surrounding forest which contains timber of considerable value may also suffer.

Free use may also be encouraged, but there will probably be but little demand for this on account of the isolation of the timber. Besides, the system of free use, by giving out small quantities to each individual, would be too slow to be of much service in controlling the present outbreak.

In case that a sale can be secured, it is necessary to use a system of cutting that will insure:

1: The destruction of the new broods of barkbeetles, by cutting and treating the timber at the proper time.

2"

2. The best economic use of the timber.

This system of cutting applies only to the newly infested trees. Dead trees, and often, those with the needles turning, are no longer a breeding place for the barkbeetles and they can be cut at any time and disposed of to the best advantage. It is the green trees bearing pitch tubes which should be carefully cut and treated. These should be selected and marked during September and October. As it now seems that the adult beetles are flying, selecting the new trees and commencing the work of bark mining and egg laying during the months of July, August and September, it would not be

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possible to mark infested trees before the first part of September without interfering with the trees which were attacked towards the last of the season. By the first of November practically all of the adults and the following generation of the bark beetles are under the bark of the newly infested trees and will remain there until activity begins again the following season. The cutting should be done now, and may be started earlier in October. It will be possible to cut through the winter, and these trees may probably also be cut if properly treated afterwards, in the early spring, but further data will have to be secured later to determine this.

The treatment of this fallen timber should depend both upon cost and effectiveness. The complete peeling of the infested bark will of course destroy the overwintering broods, but it seems possible that a more simple method will be just as effective.

Overwintering broods will perish on account of the drying and loosening of the bark which protects them. Also these broods will perish if a certain amount of moisture collects between the bark and the wood. Either one of these conditions will occur in trees which have been fallen and left on the ground for some time. It seems probable that trees which are felled in the fall and left on the ground overwinter in the snow, will have the bark sufficiently loosened by the spring to allow either moisture or excessive dryness to effect the death of the broods. By scoring the bark along the top of the fallen trunk for a width of two or three inches the loosening of the bark and the entrance of moisture

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may be considerably hastened. To test this a series of trees were cut and an experiment started, an outline of which I enclose with this report. (Photos 90211, 90213, 90214)

Trap trees. As these barkbeetles are drawn to injured and weakened trees, trap trees may also be used to advantage in the cutting. ^{Healthy} trees which are desired for cutting, if girdled in the spring, will probably be well infested by the following October. This method would be of advantage in confining the cutting to one area. Several trees were girdled during the investigation.

Transportation of timber. If the infested trees which are cut are taken away from the forest before the following spring to a distance of 20 to 40 miles from other timber, treatment will not be necessary as the issuing beetles will perish for want of trees to attack. In this case it will be necessary to peel the stumps as these are often the worst infested portion of the trunk.

Treatment necessary when the trees are left standing. In case that sale or other disposition of the timber can not be made, it may be necessary for the Forest Service to combat this outbreak on its own resources, by using ranger and temporary labor. In this case the timber will probably have to be left on the ground, and it will best to use some method of treatment by which the trees can be left standing. This can be done by removing the infested bark from the main trunk during the fall with a special barking tool. Owing to the habit of the mountain pine beetle in attacking that part of the tree covered by the thicker bark, the broods are all found on the lower part of the trunk, most of them within ten or twelve

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feet of the ground. While the upper portion of the trunk is sometimes attacked, development there is unfavorable. It is probable that by selecting the newly infested trees and removing the bark from them ~~some~~ ^{at} ~~the~~ ^{the} ~~time~~ ^{time} of the trunk of a majority of them, that this will be sufficient to check the attack. Owing to the small size of the trees and the thin-bark this should not be a very expensive process. There is also reason to believe that if the trees are barked in the early fall, that most of the broods will be weakened and killed by removing the bark from the first six feet of the trunk. Several trees were peeled to test this (photos 90212 and 90214) but more experiments should be carried out.

Control through natural agencies. In case that a sale of this timber cannot be secured, or the cost met of combatting the outbreak by hiring labor, there is still the alternative of controlling the outbreak by the introduction or breeding of natural parasites of the beetles. This however is a matter ^{time} that requires much investigation and considerable ^{time} to carry to effect. Some predaceous enemies and parasites were found preying upon the beetles on this area, and it is to be hoped that these will increase. A list of these is given here altho some of them have not yet been identified as the larvae only were found:

Trogoditid Sp. A metallic blue beetle, about one half an inch in length found under the bark and in the tunnels of the mountain pine beetle. It feeds both upon the bark beetles and their larvae.

Medeterus aldrichi. This is a small fly, the larvae

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of which is often found feeding upon the larvae and pupae of the bark-beetles. It is a very small, common wire-like worm quite different from the *Dendroctonus* larvae in appearance.

Chalcid Sp. This a true parasite, belonging to the family Chalcididae. The tiny footless larvae attach themselves to the larvae or pupa of the barkbeetle and slowly absorb them. These are the most effective of parasites.

Recommendations.

I recommend that a reconnaissance be made in this territory as soon as weather will permit in the spring. The object of this should be:

1. The location, extent and value of the infested and dead timber with an approximate estimate of the amount. These figures are essential in arranging for the sale of this timber.

2. To secure the results of the experiments already started on this investigation and to secure additional data in regard to the seasonal history of the barkbeetle also to peel the bark from a number of standing trees in order to secure some data on the cost of combatting the attack by this method.

This work can probably be done in two weeks by a party of three or four men. The present season is already too far advanced for undertaking any remedial measures on a large scale, and it will not be advisable to cut or select trees to any extent for cutting before September 1911. In the meantime every effort should be made

to arrange for the disposal of this timber, if possible at a price which will cover the cost of marking and supervision. Cutting operations cannot very well be started now before October, 1911. The final terms of agreement in regard to the methods of cutting and treatment of the infested timber, can best be arranged after more data can be secured.

Summary

The lodgepole pine in the southeastern part of the Forest is infested and dying to a considerable extent as a result of an attack of the mountain pine bark-beetle. This condition has developed recently, and much of the evidence of barkbeetle work does not exceed three years. The present indications are that the attack is increasing.

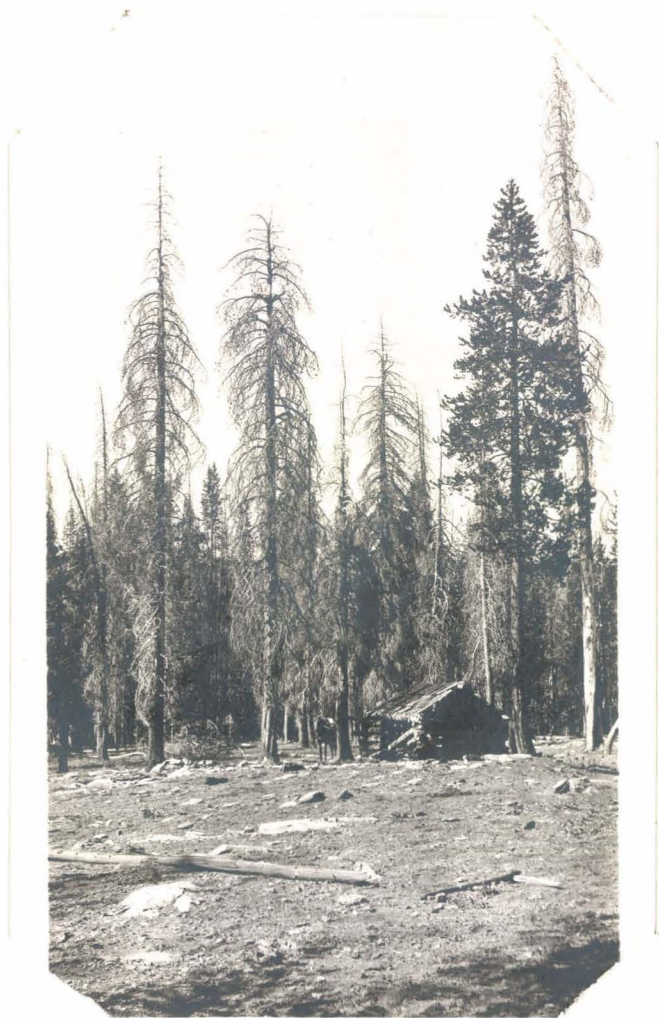
The habits of this beetle are such that the attack can be controled by using some method which will destroy the overwintering broods of larvae during their season of inactivity, between October and the following spring. This can be done in at least two ways: 1, by felling the the infested trees and either leaving them exposed to the weather so that the bark will loosen during the winter months, or by scoring or treating the infested bark; 2, by peeling the infested bark from the trees and leaving them standing. The first method can probably be used to the best advantage in the case of a sale of the dying timber; the second method can best be used if the attack is to

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be controlled by temporary labor. The success of either method should be tested by experiments, and further data secured in regard to the life histories and habits of the barkbeetles as well as the information necessary to arrange a sale of the timber.

In case that it is not possible to fight the attack directly either through sale or labor, further effort should still be made to secure control by the introduction and breeding of parasites of the mountain pine barkbeetle.

Forest Ranger.



No. 99168

insect-killed lodgepole pine on Section 17,
T30N, R7E, NDM. These trees are in the black top stage
and were probably killed during the season of 1907-8.



No. 99164
Surviving Jeffrey pine trees on burned area near
Chester, California, (TISH, EYE, MPM.). The dead trees
show abundant evidence of having been killed by the
mountain pine beetle.

Photos illustrating 1911 reconnaissance.

Lassen National Forest.

Photos from

Lassen National Forest.

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No. 99165

Large yellow pine on brush area, Section 3, T89N,

R7E. These trees are undoubtedly the survivors of severe fires. Two trees were attacked by the mountain pine beetle during the season of 1911 and are in the infested condition as shown by the fading foliage.



Lodgepole pine mixed with Jeffrey pine, mountain pine, red fir and white fir near Silver Lake, Lassen County. It is this sub-alpine type which produces the poorest quality of lodgepole.



Lodgepole pine mixed with Jeffrey pine, white fir, and red fir on Bailey Creek, T29N, R7E, MDE. This represents the best quality of lodgepole pine.



No. 99167
Dead lodgepole pine mixed with Jeffrey pine near
Bailey creek, T29N, R7E, MDM.



NO. 99174
Stand of lodgepole pine on delta where the
Susann River enters Clover Valley.



No. 99168

Lodgepole reproduction coming in under Jeffrey
pine on burned area, West branch of Rock creek, T29N,
R8E, MDM.



No. 99172

Reproduction of lodgepole pine near the Dillon Cabin,
Section 10, T29N, R7E, MM. Some of it is crowding into
the burned brush areas.



No. 99166
Lodgepole pine, quality 1, growing along
Bailey creek, Section 3, T29N, R7E, NDM. This stand is
only slightly infested.



No. 99158

Lodgepole pine crowding onto the hillsides in competition with Jeffrey pine and white fir. The best quality of lodgepole is grown under this competition.



No. 99160

condition of lodgepole pine on Section 3, T29N,
R7E, NMM. Reproduction is rapidly filling in the openings
under the dead trees.



No. 98170

Pure stand of insect-killed lodgepole pine
on Section 3, T29N, R7E, MM. Practically all trees have been
killed by the mountain pine beetle.



No. 99161

Witness tree to the SW corner of Section 17,
T30N, R8E, MDM. The survey scribe was made in 1883, and
25 rings of annual growth were counted over the scar.
The tree was evidently killed by the mountain pine
beetle in 1908.



No. 99162

A group of insect-killed lodgepole pine in the black top stage. This group includes the witness tree to the NW corner of Section 17 (see photo 99161) which was killed in 1908.



No. 98176

Dead lodgepole pine appearing in stand of Jeffrey pine,
white fir and red fir on Section 3, T29N, R7E.



No. 99159

Two trees near Clover Valley Ranger Station which were attacked and killed by the mountain pine beetle in 1910. On July 15, 1911 these still contained broods just ready for emergence. Practically all of the new beetles were under the bark within fifteen feet of the ground. Dry brush and limbs were piled around the bases of the trees and burned. A later examination showed that the heat killed practically all beetles under the bark.



No. 99175

A lodgepole pine near Deadhorse meadow on the NW4SE4 of Section 21, T20N, R7E, NDM. This tree measured 60 inches in diameter, the largest recorded on the area.



No. 99174

A distant view of the same tree shown in photo No. 99173. The height was estimated at 120 feet.



No. 99175

A group of large lodgepole pine growing on
deadhorse meadow, Section 21, T30N, R7E, MDM.



90203

A lodgepole which has been dead for more than one season, showing the seasoning check which seriously affects the merchantable quality of the wood. The old egg galleries and larval mines of the mountain pine beetle also show upon the wood.

Section I7, E30N, R8E, MDM.



90204

One of the worst stages of the seasoning check. This extends well into the heart wood of the tree. The work of a secondary wood borer, Buprestis Sp. also shows on the sap wood.

Section I7, T30N, R8E, MDM.



90219

Freshly attacked lodgepole on Section 17, T30N, R8E, MDM. The pitch tubes have weathered but little and do not differ much from the bark in color.

90212

An infested lodgepole with the bark removed to destroy the broods of the mountain pine beetle. The mark of the egg galleries shows distinctly on the sap wood. These are much more plentiful near the base.





90217

Lower trunk of a freshly attacked lodgepole pine on Section 17, T30N, R8E, MDM. The fresh pitch tubes of the mountain pine beetle show on the bark,



90216

A dead lodgepole killed two seasons ago. Most of the pitch tubes have fallen from the bark and the remaining ones have turned whitish in the weather.



90211

A group of freshly infested trees which were fallen near Favinger's camp in Sect 17.T30N,R8E,MDM. The tops of the trunks of these lodgepole have also been scored.

90220.

Condition of the lodgepole pine on Rock creek in approximately Section 33, T29N, R8E, MDM. Only a small percentage of this timber is infested.



90208

Condition of the lodgepole pine on the west side of Robber creek below Griff's ranch, Section 17, T30N, R8E, MDM. A strip of ground along the creek contains an almost pure stand of lodgepole which appears to have been thrifty up to the present barkbeetle attack.

90209

Another view of the area shown in 90208. Approximately eighty to ninety percent of the stand has been killed by the mountain pine beetle.



90205

A small group of trees attacked and killed by the mountain pine beetle on Section 16, T30N, R8E, MDM. This is about the smallest size at which lodgepole pine is attacked by this beetle.

90206

Stand of lodgepole pine on high rocky land on Section 16, T30N, R8E, MDM. But two live trees are shown here besides the small reproduction. This high ground lodgepole seems to have been the first attacked by the mountain pine beetle in this section.



90213

A group of freshly infested lodgepole which was cut on the NW4, Section 17, T30N, R8E, MDM. The tops of the fallen trunks were scored in an experiment to determine if this would aid in the loosening of the bark and the destruction of the broods of the mountain pine beetle.



90214

Two Standing lodgepole trees from which the bark has been removed to destroy the broods of the mountain pine beetle.

Section 17, T30N, R'e, MDM.



90201

Stand of lodgepole pine near Robber creek, Section 16,
T30N, R8E, M.D.M. The smaller trees show green foliage: all
the larger trees have been killed by *Dendroctonus monticolae*.



90202

An area very close to that shown in 90201. One tree is
shown in the foreground on the left which is still alive. Just
to the right of this is another with drooping needles which
died during season of 1909. Most of these trees were probably
killed three or four seasons ago by the mountain pine beetle
(*Dendroctonus monticolae*)